



VACANT WAREHOUSE FIRE

Seattle, WA

September 9, 1989



FIRE INVESTIGATIONS

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FIRE INVESTIGATION REPORT

**Vacant Warehouse Fire
One Fire Fighter Killed
Seattle, Washington
September 9, 1989**

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Publishers of the National Fire Codes® and National Electrical Code®

A non-profit membership organization dedicated to promoting safety from fire, electricity, and related hazards through research, codes and standards, technical advisory services, and public education since 1896.

ABSTRACT

On September 9, 1989, the Seattle Fire Department responded to the report of a fire in a lumber warehouse. On arrival, fire fighters found a large building with visible flames involving a 75 ft X 75 ft shed attached at the building's southwest corner. The incident quickly became a multiple alarm fire. A fire officer and a fire fighter who were in a smoky section of the main building became disoriented while looking for an area from which to attack the fire. Several circumstances caused the fire fighters to separate as they attempted to leave the area. The fire fighter was found and rescued by a fire fighter from another engine company, but the officer was not able to escape; he died of carbon monoxide poisoning.

The building, which was scheduled for demolition, was a heavy timber structure approximately 295 ft X 180 ft. and had been abandoned for about two years. The primary fuel was the structure; however, small amounts of combustible trash were scattered throughout the building. The piping for several dry sprinkler systems was still in place. Before this incident occurred, the main control valve for the water supply to all sprinkler systems had been shut off because one of the systems had been damaged.

The following factors appear to have contributed directly to the death of the fire officer:

1. The inability of fireground officers to account at all times for the location of all personnel;
2. The actions of fire fighters that failed to conform to safe fireground practices as recommended by the National Fire Protection Association and the International Fire Service Training Association, and as required by the Seattle Fire Department;
3. The inadvertent use of the wrong radio channel by two disoriented fire fighters while attempting to let others on the fire scene know that they were in need of help.

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
II.	BACKGROUND.....	2
	Fire Department.....	2
	Incident Command System.....	2
	Fire Fighter Training.....	3
	Fire Fighter Protective Gear.....	4
	Fitness Programs.....	5
	Fire Fighter Profile.....	5
	The Building.....	6
	Fire Protection Systems.....	7
III.	FIRE INCIDENT.....	9
	Fire Department Notification and Initial Response...	9
	Fire Suppression Operations.....	9
	Casualties.....	16
	Damage.....	17
IV.	ANALYSIS.....	18
	Ignition and Fire Spread.....	18
	Factors Contributing Directly to the Loss of the Fire Officer.....	18
V.	DISCUSSION.....	22
VI.	APPENDICIES.....	23
	Time Line.....	24
	Figures.....	32
	Seattle Fire Fighter Fatality, July 12, 1987.....	35
	Fill Station Air Quality Test Results.....	37
	Results of Sample Tests for Officer of E-20.....	38
	Test of Facepiece from the E-20 Officer's SCBA.....	39
	Record of SCBA Inspection.....	40
	Breathing Apparatus Test Record Sheet.....	42

I. INTRODUCTION

The National Fire Protection Association (NFPA) investigated the Blackstock Lumber fire in Seattle, Washington in order to document and analyze significant factors that resulted in the loss of life and property.

This study was funded by the NFPA as part of its ongoing program to investigate technically significant incidents. The NFPA's Fire Investigation Division documents and analyzes incident details so that it may report lessons learned for life safety and property loss prevention purposes.

The NFPA became aware of the fire two days after its occurrence on September 9, 1989. Michael S. Isner, of the Fire Investigations Division, traveled to Seattle to document the facts related to this fire. An initial eight days of on-site study and subsequent analysis of the event were the basis for this report. Entry to the fire scene and data collection activities were made possible through the cooperation of the Seattle Fire Department.

This report is another of NFPA's studies of fires that have particularly important educational or technical interest. The information presented is based on the best data available during the on-site data collection phase and during the report development process. It is not NFPA's intention that this report pass judgment on, or fix liability for, the loss of life resulting from the Blackstock Lumber fire. This report presents the findings of the NFPA data collection and analysis effort.

The firesafety conditions at the Blackstock Lumber building and the findings on factors that contributed to the loss of life or property are based on NFPA analysis of collected data and observations during the investigation. Current codes and standards were used as criteria for this analysis so that conditions at the abandoned building on the day of the fire could be compared with current fire protection practices. It is recognized that these codes and standards may not have been in effect at the time this fire occurred. NFPA has not analyzed the Blackstock Lumber building with respect to its compliance with the codes and standards that were in existence when the structure was built or during its operation.

The cooperation and assistance of Fire Chief Claude Harris of the Seattle Fire Department is greatly appreciated.

Special thanks are given to Laurie Ruszcyk for her assistance during the preparation of this report.

II. BACKGROUND

Fire Department¹

The Seattle Fire Department protects a 91-square mile port city with a population of 490,000. The department's 876 uniformed fire fighters are divided among four platoons that work alternate 24-hour shifts. In addition to the operations personnel, the department has another 121 uniformed personnel in other divisions that include emergency medical services, fire prevention, communications, training, and various support functions. The department also employs 43 nonuniformed personnel who fill several administrative and professional positions and who are spread throughout the divisions. During 1988, the department responded to 13,573 fire related calls, answered 31,031 emergency medical calls, and performed 103,617 inspections.

The department has 33 fire stations throughout the city and operates 32 engine companies, eleven ladder companies, one fire boat, seven battalion chiefs, six aid units, six paramedic units, and a variety of specialized equipment and reserve units. Most of the engine companies have an officer and two fire fighters, but seven of the engine companies are staffed with six personnel. These companies are called ERS units, which means they are part of the department's expanded response system and can be used to bring a large number of personnel to a fire scene. Ladder companies are staffed with four or six personnel.

Just over two years before this latest fire fighter fatality, the Seattle Fire Department lost another fire fighter. During that incident on July 12, 1987, the fire fighter was working independently, the individual was not accounted for over a period of time, there was evidence of fire fighter behavior that was inconsistent with normal fire suppression activities, and cause of death was inhalation of carbon monoxide (see Part 1, Appendix C). Following the internal investigation of the incident, the Seattle Fire Department took several measures in an effort to prevent the occurrence of a similar accident. Those measures included changes in the department's operation instruction for incident command, changes in its training program, and changes to the insignia system for helmets.

Incident Command System

In June 1989, the Seattle Fire Department implemented its modified departmental operation instruction (OI). The revised OI defines the department's incident command system as "a system to manage the routine small emergency as well as the very large complex incidents. A system that allows for manageable span of control and reliable accountability." The new command system was fashioned after the National Fire Academy incident command system, though its final form was prepared by the Seattle Fire Department.

¹ Statistical data was obtained from the 1988 Seattle Fire Department Annual Report.

In addition to mentioning the span of control and accountability in the definition, the incident command OI, Section I 413 addresses these issues under the section entitled "Responsibility" in the following paragraphs:

- 4.1 Each member must understand their individual responsibilities at an incident as well as the basic responsibilities of each level of the command structure.
- 4.2 All commanders or positions activated within the Incident Command System are required to know the location and status of functions, units, or individuals assigned to their direct span of control and will be held accountable.
- 4.3 All fire fighters are responsible to assist commanders within the ICS system maintain accountability for resources. Fire fighters work as part of a team and are responsible for the safety of their partner.
- 4.4 Span of control will normally be not more than five individuals, units or functions reporting to one commander. The emphasis is efficient control with accountability. The commander should divide the duties as the span of control exceeds efficiency.

Fire Fighter Training

In October 1988, a new division head assumed responsibility for training and began several projects. These projects included the revision of the department's incident command OI, the development of new OI training programs for officers and fire fighters, update of the existing training manual for the 12-week introduction to fire fighting course, and replacement of outdated equipment used for the department's training school.

When an individual is selected to be a Seattle fire fighter, he/she is required to complete a 12-week introduction to fire fighting course. This course is fashioned after fire fighter training courses developed by the National Fire Academy (NFA) and introduces personnel to fire fighting procedures, to fire prevention activities, and to the department's standard operating procedures. Upon completion of this course, recruits should be able to fulfill the requirements for fire fighter levels 1 and 2 as described in NFPA 1001-1987, *Standard for Fire Fighter Professional Qualifications*.

During the department's introduction to fire fighting course, the trainees are taught that fire fighters should always work with a partner, and this approach to fire fighting is mentioned in paragraph 4.3 of the Seattle Fire Department OI, Section I 413. Training exercises are designed so that it is not possible to successfully complete an activity if it is performed alone. In addition, since 1984 recruits have been taught to perform search and rescue

in structural fires in accordance with a procedure described by Thomas R. Griggs, M.D. and James Manning. This method specifically states that the fire fighters should work in pairs and describes how searches should be performed.²

Even though the department's new incident command OI was not implemented until June 1989, training of staff began in 1988. The first incident command training took place in November 1988 and involved the participation of officers with the rank of deputy chief and higher. A second training session for these officers took place in January 1989. In the same month, battalion chiefs and acting battalion chiefs (captains) received their first training in the new command system. These officers received their second ICS training in February 1989. In addition, a battalion chief and acting battalion chief from each platoon trained the company officers who, in turn, trained the fire fighters in the new incident command system.

Fire Fighter Protective Gear

Seattle fire fighters are issued helmets that are constructed of either fiberglass or polycarbonate. Both types of helmets meet or exceed OSHA, Washington State, USFA, and NFPA standards. The helmets are equipped with a plastic face shield, nylon strap, and two-layer ear protection fabric. The outer layer of the ear protection is PBITM/Kevlar,[®] and the inner material is a permanently flame resistant flannel fabric. The fire fighter who died in the Blackstock Lumber fire was wearing a polycarbonate helmet.

Each helmet is equipped with markings indicating the company to which the fire fighter is assigned. Both sides of the helmet have reflective symbols representing the type and number of the company to which the fire fighter is permanently assigned. In addition, each helmet has a removable triangular shield mounted to the front of the helmet. The shield bears the insignia of the company to which the fire fighter is assigned for a particular shift. For example, the fire fighter injured in the Blackstock Lumber fire normally worked at Ladder 8, so he was wearing reflective triangles with the number "8" on the side of his helmet. During this fire, he was temporarily assigned to Engine 20; as a result, his front shield displayed E-20 rather than L-8. This system of replacable front shields on helmets was introduced as a method of improving accountability after the 1987 fire fighter fatality incident.

The fire fighters are provided with 3/4-length coats and trousers. Both items have an PBITM/Kevlar^R outer shell, a thermal barrier, and a vapor/moisture barrier. Similar to the helmet, these items meet OSHA, Washington State, USFA, and NFPA standards.

² Griggs, T.R., M.D., and Manning, J., "Survive the Search and Rescue," *Fire Service Today*, May, 1983.

In addition, Seattle fire fighters are provided with knee-high boots, leather gloves with wool liners, and a personal alarm signaling system (PASS) device which conform to NFPA standards. The fire fighters' station uniform includes a shirt (65% polyester and 35% cotton) and pants (Nomex®).

All the self-contained breathing apparatus in the department are of a positive pressure type and conform to NFPA standards. The department refills all of its SCBA bottles. The refilling station is tested every month by the University of Washington, and the test records for August 1989 and September 1989 indicate that the air quality from the filling station was good. (See Part 2, Appendix C.)

Fitness Programs

In 1982, the Seattle Fire Department initiated the physical fitness program that is currently being used. The program requires that all candidates for uniformed positions on the department pass a cardiovascular test and an agility test that assess strength, endurance, and stamina. Once a member of the operations division, personnel are required to have a cardiovascular evaluation, and to take a submaximal grade treadmill test and body composition (fat) test every two years. If a person fails either test, they may be placed on light administrative duty and may be required to participate in a physical exercise program.

All engine and ladder companies are required to perform annual exercises at the department's training center. These exercises are required in order to evaluate the competence of fire fighters while they work as a company unit. In addition, an individual's physical ability to perform standard fire fighting tasks can be evaluated.

The Seattle Fire Department also has a voluntary medical monitoring program. Personnel who wish to participate receive an extensive annual physical. During this physical, tests are performed to detect exposure to hazardous materials such as asbestos, lead, and PCB's, urine samples are examined for blood or abnormal protein levels, cholesterol levels are measured, and many other tests are performed. Approximately 65 - 70 percent of the operations personnel participate in this program.

Fire Fighter Profile

The officer for Engine 20 was 32 years old and had joined the Seattle Fire Department in 1980. In addition to completing the required introduction to fire fighting course and the required ongoing company training during his career, this officer had obtained Washington State certification as an Emergency Medical Technician (EMT), earned a Bachelor of Science degree in Community Health Education, and completed others training for example, a course in conflict resolution, in October 1988. This officer had also published the article "Recognition of Child Abuse Situations," which appeared in the July/August 1982 issue of *Emergency Medical Services*.

He was promoted to the rank of lieutenant in July 1989 and had acted as a company officer on an "as needed" basis for several years.

The fire fighter on Engine 20 was 42 years old at the time of the fire and had been a Seattle fire fighter for 17 years. Like the officer, this fire fighter successfully completed his initial training and all company training as required. In addition, he successfully completed supplemental training such as the Emergency Management of Hazardous Materials course offered by the Seattle Fire Department.

Both fire fighters were reportedly in good health, and neither was a smoker.

The Building³

The Blackstock Lumber building was constructed in the 1920s. This building most closely resembled heavy timber construction, which according to NFPA 220-1985, *Standard on Building Construction* 1985 edition, is listed as Type IV, 2HH construction.⁴ The building was constructed on top of a grid of evenly spaced concrete piers that varied in length according to grade. Wood beams measuring 10 X 10⁵ were placed on the piers and supported the wood floor assembly, which consisted of 3 X 14 joists, 2 X 10 subflooring, and 1 X 4 finish floor boards. Regularly spaced 10 X 10 wood columns supported 10 X 12 wood beams which in turn supported a roof assembly.

Interior walls that extended through the roof assembly divided the building into several areas, which will be labeled Sections A, B, C, D, E, F, and G (see Figure 1, Appendix B.) These walls had parapets that were about two to three feet high. The walls were constructed with two layers of

³ Current codes, such as NFPA 220-1985, *Standard on Types of Building Construction*, will be used in this report to compare existing conditions in the facility to selected requirements of current NFPA codes. It is recognized, however, that these codes were not in effect during the construction of this facility.

⁴ According to NFPA 220 criteria, 2HH construction includes combustible structures in which the minimal dimension of beams and girders that support floors, and that support roof loads only, are six inches and four inches, respectively. Wood columns supporting roof loads only are not to be less than six inches.

⁵ Dimensions of construction materials represent inches and are approximate.

vertical 2 x 6⁶ tongue and groove planks. A material that appeared to be gypsum wallboard was sandwiched between the two layers of planking.

Because of the parapets, the roof was also divided into Sections A - G, and each roof section was arched. The arch was formed by differences in column heights. The columns adjacent to the east/west parapet walls were a given length. Columns in the center of the section were a few feet taller. Rafters measuring 2 X 12 sloped up to an east/west line of columns toward the center of the section. Another series of rafters ran horizontally to a second east/west line of columns. A third series of rafters sloped down to the next east/west parapet wall. The rafters supported 1 X 8 wood sheathing. Several layers of asphalt paper and roofing tar covered the wood materials to provide the watertight seal for the roof.

While in use, the building contained lumber in large storage bins, machinery areas where lumber was milled, and several offices at the front (east face) of the building. The storage and machinery areas were open and extended up to the underside of the roof assembly approximately 20 feet above the floor. Section B had several large storage bins that were defined by boards nailed to the wood columns. There were two levels of rooms constructed along the east wall of Sections A, B, and C. The rooms on the first level appear to have been offices and retail spaces, and the rooms on the second level appear to have been offices and storage.

At the time of the fire, the building had been abandoned for about two years and was scheduled for demolition. Due to the extent of fire damage and the removal of much of the debris by arson investigators, it was not possible to establish the quantity of combustible materials that may have been left in the building. However, evidence in one area suggests that all of the valuables and the vast majority of the combustible contents had been removed. The only identifiable combustible contents were a few small piles of combustible trash like papers, broken pallets, and wood debris.

Fire Protection Systems

The building had been equipped with four dry sprinkler systems, which were not in service at the time of the fire. The systems were supplied through a single manifold and connection to the municipal water system. The supply main for the sprinkler system manifold entered the building on the Elliot Avenue side, and heated areas for the dry valves were located in Section B. The systems were provided with a single fire department connection, and this connection was located on the east side of Section B facing Elliot Avenue.

⁶ Dimensions of construction materials represent inches and are approximate.

At some time before the fire, the piping for the sprinkler system in the southwest corner of the building was frozen and damaged. To stop the water leakage, the main supply valve for the sprinkler system manifold was closed, putting all sprinkler systems in the building out of service.

III. FIRE INCIDENT

Fire Department Notification and Initial Response

The deputy chief in charge of Battalion 1 (this chief will be referred to as B-1) was at the Seattle Fire Department dispatch center when the call reporting the fire at the Blackstock Lumber facility was received. While listening to the telephone conversation, he believed, due to the content of the call, that there was most likely a fire in progress, and he left for the scene immediately. Upon completion of the call, the dispatch center initiated the first alarm response at 9:21 p.m. The assignment included Engines 2, 4, 5, 8, 10, and 20; Ladders 4 and 6; Med 10; and B-1 and B-2.

B-1 arrived on the scene at 9:23 p.m. before any other fire department units. He found a 75 ft X 75 ft shed adjacent to the southwest corner of the building completely involved in fire, and it appeared that the fire could have been extending into the building. (See Figure 2, Appendix B.)

B-1 immediately assumed the role of incident commander (IC) and established his command post near the southeast corner of the building. He designated the Elliot Avenue side of the building (east side) as Division A; the south side of the building, where the burning shed was located, as Division B; the west side facing the railroad tracks as Division C, and the north side of the building as Division D. From his initial size-up, B-1 also decided that he would attempt to extinguish the fire in the shed and to push any fire that might be in the building back out through the southwest corner.

Fire Suppression Operations

Engine 2 (E-2) arrived shortly after the IC, and this company was directed to position its manifold on the front side of the building.⁷ Ladders 4 and 6 (L-4 and L-6) had also arrived by this time and were directed to go to the roof. E-5 and E-8 arrived at about 9:25 p.m. and were assigned to initiate the attack on the shed.

E-20 approached the scene from the north, and as it arrived at approximately 9:25 p.m., the IC instructed the crew to position its manifold in front of the building. The driver turned the engine around and the officer and fire fighter removed the manifold, skid load, and other equipment. The driver then drove to a hydrant several hundred feet north of the building because E-2 was already using the hydrant near the northeast corner of the building.

⁷ A manifold is an appliance with two 3 1/2-inch supply connections and six 2 1/2-inch discharge connections for attack hose lines. This appliance can be used as a portable hydrant.

The IC contacted the dispatch center at 9:26 p.m. and requested a "special call" be initiated to bring more personnel and equipment to the scene. Two engines (E-9 and E-25) and a ladder company (L-1) were dispatched.

While the E-20 crew was positioning hose lines and preparing to enter the building, fire fighters from L-6 and L-4 were beginning to ventilate the roof. The L-6 crew was the first on the roof and went to an area over Section G on the west side of the parapet. This crew was forced to leave its position by flames coming through a hole that the crew had cut and by intense radiative heat from the flames at the building's southwest corner. L-6 joined the fire fighters from L-4, who were working the roof above Section A.

The L-4 fire fighters attempted to make a trench cut in roof above Section A close to the north/south parapet wall. Flames and heat immediately came out of the small opening left by the chainsaw blades, so the crew moved to another area further east in Section A. At this location, they were able to make the trench cut, but smoke and flames quickly came out of this hole as well.

E-4 is the Seattle Fire Department's fire boat. It approached from the waterfront (west side of the building). While responding, the E-4 crew could see that the fire at the southwest corner of the building was rapidly spreading to the north. The fire boat arrived at about 9:27 p.m. and was assigned to manually stretch hose lines to the building because it was out of the reach of the shipboard nozzles. These operations were delayed because the hose had to be stretched over railroad tracks and train traffic had to be stopped.

B-2 arrived on the scene at about 9:28 p.m. and was immediately assigned to command Division A, on the Elliot Avenue west side of the building. Though he was not specifically told the strategy for this fire, B-2 decided that an aggressive interior attack was appropriate because it appeared that less than 20 percent of the building was involved and because the ladder companies were already on the roof ventilating the building, a standard operation in Seattle when engine companies are performing interior attacks.

B-2 had fire fighters bring a hose line to the roof to protect the crews working there, and he had some fire fighters from L-4 open the front of the building so that the engine companies could enter. After a small personnel door that was part of in a larger vehicle door was opened, the officer and fire fighter from E-20 entered Section B. This crew, reportedly, had their SCBA facepieces on and began to move a 2 1/2-inch hose line and nozzle into the building. While positioning this hose, the fire fighter accidentally opened his bypass valve, and his facepiece was raised up off his face, leaking some of his air.

The E-2 crew began searching for fire in the offices at the southeast corner of the building. When the crew was unable to locate the fire, one fire fighter, with permission from the E-2 officer, went to Section B to see if there was access to the fire from that section. She found smoke to be light and overheard the E-20 officer and fire fighter talking to one another. The E-2 fire fighter indicated that she thought they had their facepieces on by the sound of their voices. While in Section B, the E-2 fire fighter did not find any access to the fire in Section A.

L-1 arrived on scene about 9:31 p.m. and was assigned to the roof. The IC designated the L-1 officer as the rooftop commander, and this crew went to the roof above Section B to ventilate. When L-1 opened the roof, the fire fighters found no fire and only light smoke.

The crew from E-5 was still working the offices at the southeast corner of the building when one of its fire fighters ran out of air. The entire crew left the building to change air cylinders. While outside, this crew was told to put a hose line into the building's sprinkler connection. A 2 1/2-inch hose was stretched from E-2's manifold, which was already in front of the building, and the connection was made by about 9:45 p.m. The E-5 crew was also ordered to set up a monitor nozzle at the north side of the building. It positioned its engine at the northeast corner of the building and operated a heavy stream.

While in Section B, the E-20 fire fighters searched a room that contained light smoke at floor level. The fire fighters found a stairway on the south wall and another stairway on the north wall. After searching the ground floor and failing to locate the fire, they decided to leave the building and confirm the location of the fire.

Once outside, the E-20 officer and fire fighter saw that the fire remained in the southwest corner. They also took a moment to change the fire fighter's air cylinder because of his accidental loss of air. Then they went back inside.

The E-20 officer and fire fighter returned to the nozzle, which was about 40 feet into the room, and still could not locate the fire. The officer allowed the fire fighter to leave the nozzle to see if there was any fire in the area above the offices. The fire fighter went up the north stairway but found nothing.

At 9:43 p.m. the IC made a second special call, which resulted in two ERS pumpers being dispatched to the scene, and he called for a third alarm at 9:44 p.m. Three engines plus one ladder were dispatched. It was at about this time that fire and smoke were venting along the entire length of the building's west side, and several sections of roof near the southwest corner of the building had collapsed. However, the front of the building was still intact.

The fire fighters on the roof were experiencing a lot of radiant heat from the huge fire in Section G. A second hose line was brought to the roof and fire fighters on the roof in Section B began to operate the 2 1/2-inch handline directly into the flames.

As the E-20 fire fighter was returning to the nozzle, conditions in Section B quickly changed. The heat in the space increased dramatically, dropping down like a curtain. By the time the fire fighter reached the nozzle, the officer was gone. Thinking that the officer may have already left the building, the fire fighter followed the hose back out of the building.

Once outside, the fire fighter could not find the E-20 officer and went to another fire fighter who appeared to be in charge of the area because he was using a clipboard. The E-20 fire fighter reportedly told this fire fighter that "we had a problem here, there was possibly somebody in there."⁸ The E-20 fire fighter then went back into the building to get his partner.

It was about 9:45 p.m. when the assistant chief in charge of the operations division arrived. He parked his car north of the fire scene and began to walk around the building to size-up the situation. The entire rear of the building (Sections E, F, and G) was involved with flames that extended high into the air. The roofs over these sections, as well as most of the building's west wall, had collapsed. In addition, fire heavily involved Sections A and C. Fire fighters in Divisions B, C, and D were operating monitors and handlines from the exterior. The assistant chief also noted that some fire fighters were still on the roof.

The senior officer for the fire department's medical unit also arrived at about 9:45 p.m. and was assigned to be the commander of the staging area.

After searching the hot and smoky Section B, the E-20 fire fighter located the missing officer. Together these fire fighters attempted to find their way out of the building but were unable to do so. The officer tried several times to call for assistance over his radio. He then indicated to the fire fighter that he was low on air and gave the radio to the fire fighter. The officer then laid down, possibly to conserve air.

The fire fighter also attempted to call for assistance and got no response. He could hear the fire department dispatcher providing move-up information to fire companies, so he knew the radio was working. Thinking that the officer's PASS alarm, which was operating, might be interfering with his transmission, the fire fighter moved away from the officer and transmitted. Again, there was no response, so he felt that

⁸ Though this conversation was reported by the injured fire fighter, it was not possible to identify any fire fighter on the fireground who had a clipboard nor was it possible to confirm that the conversation occurred.

nobody knew they were in the building and that he would have to leave the officer to get assistance. The E-20 fire fighter also felt that he was still in good mental condition at this time.

While trying to leave, the fire fighter became even more disoriented and could not find his way out of the building. At one time, he thought he had actually left the building and was sitting against Engine 20, and at another time he thought he saw the figure of a fire fighter but it was actually a mirage. The E-20 fire fighter does not remember when he was found or by whom; however, he does have sporadic memory of being in the medical unit.

While the E-20 fire fighter was trying to find his way out of the building, crews from E-2 and E-25 were attempting to enter Section A and were experiencing great difficulty. The E-2 fire fighters were using a handline to protect E-25 fire fighters while they attempted to enter the small corridor leading to the open area of Section A. The fire coming out the corridor was of such intensity that the E-25 fire fighters only entered a few feet before being forced out.

One of the fire fighters from E-2 ran out of air and went back to his engine to replace his air cylinder. On his way back to the southeast corner of the building, he passed by the office just south of the personnel door where E-20 crew had entered. The E-2 fire fighter heard a PASS device activate, looked into the office, which had only light smoke at ceiling level, and saw the E-20 fire fighter stumbling around.

The plate glass windows for the office had already been broken out, and the fire fighter inside stumbled out through the window opening. This fire fighter had begun to walk around outside when he tripped over a hose. The fire fighter from E-2 went to him and asked if he was O.K. Even though the E-20 fire fighter replied "yeah," the E-2 fire fighter felt there was a problem because the other fire fighter was having difficulty standing up.

The E-2 fire fighter recalled that the injured fire fighter did not have his mask on, that his face was cherry red, and that his coat was crisp. The E-2 fire fighter also recalled that the injured fire fighter had a radio, which normally signified the rank of an officer but was wearing a helmet that had the color appropriate for a fire fighter. In addition, the symbols on the side of the injured man's helmet indicated he was from a truck company. Therefore, the E-2 fire fighter thought the injured fire fighter was an acting officer from a truck company that had been split up. The E-2 fire fighter never saw the helmet's front shield displaying the "E-20" identification.

The Division A commander, B-2, saw the two fire fighters in apparent distress and went to them. The E-2 fire fighter told the officer that the fire fighter, who was now standing but slumped over, was "out of it." When asked where the injured fire fighter was from, the E-2 fire fighter believes he responded "Ladder-6" because of the symbol on the side of the helmet.

The officer, seeing the radio and the "E-20" on the injured fire fighter's helmet, thought that fire fighter was acting as officer for E-20. The Division A commander also saw the "E-2" on the other fire fighter's shield and thought the shield said "E-20." This division commander made a notation that the E-20 crew was out of the building and told the fire fighter to take the injured man to the medics in the staging area.

The E-2 fire fighter brought the injured man to Med-10 and told the medics that he had found this fire fighter. The medics took the E-20 into their vehicle in order to begin treatment, and the E-2 fire fighter went back to the southeast corner of the building to join his crew.

Upon completing his size-up, the assistant chief of operations felt the strategy for this incident should be that of an exterior defensive attack. The assistant chief of operations met with the IC, assumed command of the fire at about 10:00 p.m., and ordered the fire fighters off the roof. The previous IC (B-1) became the operations chief. The new IC maintained the exterior defensive posture of the suppression activities.

At about 10:15 p.m., the staging commander was replaced by a deputy chief, and the first staging commander assumed command of the medic units in the staging area.

The new IC called for a fourth alarm at 10:18 p.m. This alarm brought two more engine companies to the scene.

It was at about this time that the last fire fighters were leaving the roof. One fire fighter was on a ladder near the entrance door to Section B when a huge ball of blue flames exploded out of the door and almost burned the fire fighter on the ladder. With this explosion of flames in Section B, the last portion of the building without any fire visible from the outside became fully involved. The E-20 officer was found in this section of the building.

One of the L-8 fire fighters was assigned to go with the medic unit while they transported the injured E-20 fire fighter to a local hospital, and the commander of the medic units informed the IC that the E-20 fire fighter had been taken to the hospital. The fire department's safety officer (a captain) arrived about this time and was assigned to the incident safety officer, a deputy chief.

The injured E-20 fire fighter was admitted to the hospital at 10:35 p.m., and the L-8 fire fighter gathered the injured man's gear, including the portable radio. Med-10 and the L-8 fire fighter returned to the fire scene. He put the bunker gear back on L-8 (because the E-20 fire fighter is normally assigned to that company) and brought the SCBA, helmet shield, and radio back to E-20.

When the L-8 fire fighter attempted to return the radio to the E-20 driver, the driver indicated that the E-20 officer was working the fire. After this

conversation, the L-8 fire fighter returned to the staging area and looked for the E-20 officer on his way back. The L-8 fire fighter told his officer, who was working in staging, that he had the E-20 portable radio, that the officer was working this fire, and that he could not find the E-20 officer. The L-8 officer informed the staging commander what he had just been told by the fire fighter. Thinking that the E-20 officer had misplaced his radio, the staging commander took the portable radio and indicated that he would return it to E-20.

The department safety officer had been working Division A for about 45 minutes when he approached the L-8 fire fighter who had gone to the hospital with the E-20 fire fighter. The L-8 fire fighter asked the safety officer if anyone had found the officer from E-20. The safety officer inquired why the L-8 fire fighter was concerned about the E-20 officer, and the L-8 fire fighter explained the previous events. From this conversation, the safety officer realized that the officer might be missing. The department safety officer immediately brought his concern to the incident safety officer who told him to try to locate the officer on the perimeter of the fire building.

After a quick search of the fire scene, the department safety officer informed the incident safety officer that he could not find the E-20 officer. The incident safety officer relayed the information to the officers at the command post. The command officers had a quick conference and then several officers went to ask fire fighters whether they had seen the E-20 officer. In addition, a fire fighter was sent to the hospital to get whatever information the injured fire fighter could provide. During the initial questioning, the E-20 fire fighter was incoherent; however, after a period of time, he was able to provide some details regarding his activities. With this information and since no one on the fireground had seen the missing officer, it became evident that the E-20 officer was probably still in the building, which was completely involved in fire.

At approximately 11:45 p.m., the fire had been knocked down in most areas and only hot spots remained in the areas where it was believed that the missing officer would be most likely found. The fire was considered under control at 11:48 p.m., and as the amount of fire decreased, the deputy chief of training and the E-41 crew entered Section B to begin the search. Gradually, other companies were assigned to the search. Some companies were directed to Section B, and others were assigned to begin searching Sections C and D.

The missing officer was located in Section B, approximately 80 feet from the door he entered and under about two feet of debris. (See Figure 3, Appendix B.) The search took about one hour, and the officer was dead at the time of discovery.

Fire suppression and overhaul operations continued for several more hours, and the investigation in the building began as soon as investigators

could safely enter the area. Because of the ongoing investigations, the fire department maintained control of the fire scene for five days.

Casualties

One fire fighter, (the officer from E-20), died and two fire fighters (one from E-20 and the other from L-1) were injured.

The King County Medical Examiner's report cited the cause of the officer's death as "inhalation of products of combustion" based on a carboxyhemoglobin level of 63% and soot throughout his tracheobronchial tree. The report also indicated that there was extensive soot covering his face and 30% to 40% of his body was affected by postmortem burns. The results from body fluid tests are provided in Part 3, Attachment C.

The officer was found lying on his right side with legs slightly flexed, his right arm extended at almost a 90° angle to his body, and his left arm laying along his left side. All of his fire fighting gear was on. The back and left side of his helmet and the left side of his ear protector, which was down, were heavily damaged by fire. His SCBA facepiece was on. The left edge of his SCBA facepiece's plastic outer lense had begun to shrivel up because of heat exposure. However, the inner plastic lense was intact. The SCBA facepiece was tested, and the test established that it was capable of maintaining a seal. In addition, the entire SCBA was inspected, and it was determined that the SCBA was still in operating condition. (See Parts 4 and 5, Attachment C.)

The officer's bunker coat, bunker pants, and his clothing underneath were also damaged by heat, though the extent of damage varied between material layers. The left side of both bunker pant legs and the right arm of the coat were blackened. Three burn-through areas occurred on the left side of the coat. The largest burn-through area was about 10 to 12 inches across and was located over the left shoulder blade. A smaller burn-through was located at approximately the center of the back, left side, and another small burn-through was located at the lower back, left side.

The coat's vapor barrier had only one burn-through area located over the left shoulder blade and had heat damage consistent with the other burn-through areas in the outer shell. Similarly, the coat's inside liner had only one burn-through area, and that was also located over the left shoulder blade. Heat damage had also occurred on the liner's back left side, but this damage was not as extensive as that located on the vapor barrier. The back left side of the officer's utility shirt was discolored by heat and had a very small burn-through area also near the left shoulder blade, and even his white undershirt had some discoloration (back, left side) due to heat.

The fire fighter from E-20 was suffering from heat exhaustion when brought to the medic unit on the scene. The medics also indicated that the fire fighter's color was extremely gray, he was sweating profusely, and he was extremely warm. They took an oral temperature reading after he had

been undressed, and the reading was 105°F. The medics believe his core temperature probably was higher. They began their examination and became concerned about possible cardiac arrest.

While at the scene, the E-20 fire fighter was given a high concentration of oxygen and two ringers of IV fluid. Once in the hospital, his temperature was taken in the emergency room and it was slightly above 102°F. He was given more IV fluid and a treatment of ice packs to bring his temperature down.

In addition to heat exhaustion, the E-20 fire fighter suffered carbonmonoxide poisoning and sustained first and second degree burns. Tests performed at the hospital determined that he had a carboxyhemoglobin level of 14.7 percent. Areas on his face that had not been covered by the SCBA facepiece and his ears received the most severe burns. In fact, the burns left a distinct outline of his facepiece. He also received a second degree burn on his wrist.

The second injured fire fighter was from a ladder company that had been working on the roof. This fire fighter also experienced heat exhaustion, was treated on the scene, and was transported to the hospital for further treatment.

Damage

The building was completely destroyed by the fire. The shed at the southwest corner, the building's west wall, and the entire roof had collapsed and had been consumed by fire. Many of the interior partitions for Sections A, B, C, and D and the entire east wall (front of the building) remained standing but were heavily damaged by fire.

IV. ANALYSIS

Ignition and Fire Spread

Fire investigators from the Seattle Fire Department and assisted by the Bureau of Alcohol, Tobacco, and Firearms (ATF) found evidence of accelerant at several locations on the west side of the building and have determined that the cause of this fire was arson. Their investigation of this fire continues.

Upon arrival, B-1 found what he thought was a large shed fire that could possibly be extending into the building. Had his assessment of the fire been correct, it appears that the aggressive interior attack, combined with an exterior attack on the shed, might have resulted in the rapid containment of this fire and its quick extinguishment. However, the multiple fire sets appear to have complicated this fire scenario and reduced the potential for an accurate initial assessment by fire fighters outside of the building.

In retrospect, the fire involved much more of the building than originally perceived. The fire investigators determined that the fire simultaneously involved several sections on the west side of the building. (See Figure 3, Appendix B.) In addition, the shed was apparently ignited independently of the other sections and was fully involved at the time of the first officer's arrival. Fire fighters were reporting heavy fire in Section A within 10 to 15 minutes of their arrival. Approximately 20 minutes after fire fighters arrived, walls and roof sections were collapsing, and the fire that was visible from outside involved most of the building's west side. All sections of the building were involved within approximately one hour and ten minutes after the first telephone report of the fire.

Despite the intensity of the fire, which might have suggested the existence of large quantities of combustible contents, the building contained very few combustible materials. There were only small piles of combustible trash in Section B, which is assumed to be representative of other sections of the building, but no evidence of any material that would cause such a massive fire. Thus, the primary fuel for this multiple alarm fire was the 60-year old wood forming the building itself.

Factors Contributing Directly to the Loss of the Fire Officer

1. The inability of fireground officers to account at all times for the location of all personnel;

Paragraph 6-1.6 of NFPA 1500 - 1987 *Standard on Fire Department Occupational Safety and Health Program*, requires that a standard system be used to identify and account for the assignment of each member at the scene of an incident. In the appendix to this standard, the committee provided supplemental information regarding this code section. The appendix section states that accountability for each member is simple when all members arrive as assigned crews on fire apparatus. The identity of

each member should be recorded in a standard manner on the vehicle, and each company officer is responsible for those members. The command system should be set up to account for the assignment, position, and function of companies.

Following the loss of the fire fighter in July 1987, the Seattle Fire Department developed and adopted systems that were intended to provide reliable accountability. The department's Operational Instruction 413 outlines the incident command system. Sections 4.2 and 4.3 of that O.I. clearly state that commanders must account for all personnel under their control. In addition, Section 4.4 of the same O.I. attempts to limit a commander's span of control to a reasonable size. The Seattle Fire Department also established the helmet insignia system to assist commanders in the identification of members of specific crews. This system, when used in conjunction with the department's incident command system, appears to conform with the intent of Section 6-1.6 of NFPA 1500.

The loss of the E-20 officer showed that tracking fire fighters at the crew level can contribute to the breakdown of a department's accountability system when other failures in the system also occur. In this incident, the first failure of the accountability system occurred when the E-20 officer left his nozzle without his partner's knowledge of where he was going. A second failure occurred when the E-2 fire fighter (who immediately became concerned for the well-being of the injured man) found the incoherent E-20 fire fighter, misidentified the crew to which he belonged, and did not question where the rest of the injured fire fighter's crew was. The third failure occurred when the Division A commander misread the helmet insignias and considered the two fire fighters to be part of the E-20 crew. The fourth failure occurred when Med 10's crew received the injured fire fighter. At this time, medical personnel were in charge of the staging area and had the responsibility of accounting for crews entering the area. The medical personnel immediately began to treat the deathly ill fire fighter without accounting for the entire E-20 crew. With each respective failure, the fireground officers' ability to account for the missing fire officer diminished.

Since the loss of the E-20 fire officer, the Seattle Fire Department has developed and is refining a system to individually account for all fire fighters at a fire scene.

2. The actions of fire fighters that failed to conform to safe fireground practices as recommended by the National Fire Protection Association and the International Fire Service Training Association, and as required by the Seattle Fire Department;

Both the E-20 fire fighter and officer left their hose line and operated in areas where they likely could not communicate with one another due to their distance from each other, darkness, and smoke in the area. This

practice is inconsistent with NFPA standards, International Fire Service Training Association (IFSTA) guidelines, and Seattle Fire Department policies.

Paragraph 5-3.7 of NFPA 1500 provides the following requirement for fire fighters when using SCBA:

5-3.7 Members using SCBA shall operate in teams of two or more who are in communication with each other through visual, audible, physical, safety guide rope, electronic or other means to coordinate their activities, and are in close proximity to each other to provide assistance in case of an emergency.

In its publication, *Self-Contained Breathing Apparatus*, IFSTA provides the following safety guidelines:

Always work in pairs, and stay in oral or visual contact with the other member of the team. Fire departments should appoint safety officers to keep track of self-contained breathing apparatus wearers at emergencies.

Stay in contact with a wall, hose line, or lifeline.

Self-contained breathing apparatus users should always work in pairs and be in contact with another self-contained breathing apparatus wearer stationed in a safe atmosphere and equipped to provide help if needed. Contact could be by sight, lifeline, radio, or talking.

The Seattle Fire Department training school teaches candidate fire fighters that they must work together as a team in order to accomplish the many tasks required in fire suppression and to ensure their safety. Typically, company officers will reinforce the team approach during station drills and during actual incidents. Teamwork among fire fighters is also addressed in Section 4.3 of the Seattle Fire Department Operation Instruction 413, which states "... fire fighters work as part of a team and are responsible for the safety of their partner." The separation of the E-20 crew was not consistent with these departmental policies and contributed to the E-20 fire fighters' inability to ensure one another's safety.

3. The inadvertent use of the wrong radio channel by two disoriented fire fighters while attempting to let others on the fire scene know that they were in need of help.

The injured E-20 fire fighter reported that both he and his officer attempted to call for assistance using their portable radio. Several individuals at different locations away from the fire scene were using scanners and listening to the radio communications. These individuals have stated that they heard at least one request for assistance by fire fighters. No one on the

fire scene or at the dispatch center indicated that a transmission had been heard. Had it been received by units at the fire scene, a search for the fire fighters in distress could have been initiated.

The Seattle Fire Department portable radios are equipped to broadcast on multiple channels and in three different modes. The fire department uses two channels (F-1 and F-2) for fire response, though F-2 is the primary fireground channel, and seven channels (F-3 through F-9) are used by the medical units. Mode A allows all radio traffic to go through a repeater system to ensure that vehicles on a scene can communicate with the dispatch center. Mode B does not include the repeater and is used between companies once they are committed to a fire scene. Mode B transmissions usually are not received at the dispatch center. Mode C is a low power frequency, which allows very localized broadcasts between radios.

The E-20 fire fighter stated that he knew his radio was working because he could hear "move-up" information being given. In order to keep the fireground radio channel clear, the dispatch center broadcasts "move-up" instructions only over F-3. Therefore, in order for the E-20 fire fighter to hear this information, he could not have been on the normal fireground channel, F-2. This theory is supported by the fact that no one on the fireground using channel F-2 heard the broadcasts from E-20. The only individuals who heard the requests for assistance were on scanners, which likely would have been monitoring all fireground channels including F-3.

It also appears that the E-20 radio was in the "B" mode and did not transmit through the repeater. The dispatch center did not hear the E-20 transmission, and a portable without the repeater would not have the power to reach the dispatch center from the Blackstock building. All the scanners that received the transmissions were within the broadcast range of the portable radio operating on its own.

V. DISCUSSION

NFPA statistics reveal that in the period from 1978 to 1988, 47 fire fighters died in the United States during fire suppression operations involving idle and vacant buildings and buildings that were scheduled for or involved in demolition. These statistics show that the understood risks associated with fire suppression apply even to vacant properties and to buildings scheduled for demolition. Since these structures tend to be of low value and may have no associated life hazard, tactics and strategies selected by fire officers can emphasize the safety of those involved in suppression.

Conditions present during the Blackstock fire have been documented in other incidents during which fire fighters have died. For example, on March 12, 1987 in Detroit, Michigan, a fire occurred in an abandoned building. This fire resulted in the loss of three fire fighters. Similar to the Blackstock incident, the building was large and responding fire fighters could not immediately determine the severity of the fire. In both incidents, information gathered during the initial size-up led fire officers to believe that interior attacks were appropriate and fire fighters entered the buildings. However, fire conditions in these buildings were more severe than the original assessments suggested, consequently, the risk to the fire fighters was greater than anticipated.

The initial evaluation of a fire scene can take place at a time when facts are difficult to gather. Despite this, an attack strategy will be devised by the officer in charge. As conditions change, particularly if they worsen, the officer may have to adjust the strategy and related plan. In situations where a building is abandoned and there is no perceived life hazard, the officer in charge may select a fireground attack strategy that does not commit fire fighters to an interior attack and reduces the associated risks.

Another similarity exists between the Blackstock Lumber fire and the fire in Detroit: Both buildings involved had complete but inoperative automatic sprinkler systems. At least one of the sprinkler systems in the Blackstock building had been damaged so the water supply to the sprinkler systems had been shut off. Similarly, the sprinkler systems in the Detroit building had been shut off when the building was abandoned. Had the sprinklers been operational in either building, these systems could have controlled or extinguished the fires, and reduced the risk to fire fighters.

VI. APPENDICES

- A. Time Line**
- B. Figures**
- C. Attachments**

Part 1	Seattle Fire Fighter Fatality, July 12, 1987
Part 2	Fill Station Air Quality Tests
Part 3	Results of Sample Tests for Officer of E-20
Part 4	Test of the Facepiece from the E-20 Officer's SCBA
Part 5	Record of SCBA Inspection
Part 6	Breathing Apparatus Test Record Sheet

TIME LINE*,**

9:21 p.m. Dispatch center receives a telephone call reporting a fire at the old Blackstock Lumber facility.

First assignment is dispatched. The units are Engines 2, 4, 5, 8, 10, and 20; Ladders 4 and 6; Med 10; and B-1 and B-2.

While responding, the E-4 (fireboat) crew can see that the west side of the building is showing heavy fire.

9:23 p.m. B-1 arrives on the scene; his is the first unit to arrive.

B-1 finds that a large shed at the southwest corner of the building is fully involved with fire and that the fire appears to be extending into the building at that point.

B-1 establishes a plan to directly attack the fire that is involving the shed and sends a crew inside the building in order to push the fire back out through the damaged corner of the building.

Med 10 arrives on the scene.

E-2 arrives and is directed to lay a manifold (an appliance with two feed connections and several discharge connections that will be used to supply attack hose lines) in front of the building.

E-2 crew is assigned to attack the fire in the shed.

L-4 arrives; crew members set up to go onto the roof.

L-6 arrives and parks near the southeast corner.

9:25 p.m. E-20 arrives on scene; B-1 tells crew to lay manifold on the front of the building.

* Dispatch times are exact and have been obtained from fire department records.

** Other times are estimates. The dispatch center's tape recorder malfunctioned, and no recordings were made of the radio transmissions.

9:25 p.m.

E-2 has already connected the manifold to the hydrant closest to the building's northeast corner.

E-8 arrives and is assigned to run hose lines from E-2's manifold and to cover the south side of the building.

9:26 p.m.

First Special Call is made, and E-9, E-25, and L-1 are dispatched.

E-20 crew places manifold near the entrance door to Section B and pulls its skid load off the engine.

E-5 arrives; lays manifold in front of building and has E-2 pump into it.

E-4 (fire boat) arrives.

E-5 crew enters the first floor office area to look for the fire.

E-8 crew begins to attack the fire involving the shed at the southwest corner of the building.

B-2 arrives and is assigned to command Division A. He sees that ladder crews are already on the roof, which indicates that an interior attack is already in progress.

B-2 is not specifically told the tactics or strategy for his division, so he assumes the attack will be an interior type and takes appropriate actions.

E-20 crew enters the building.

B-2 orders L-4 crew to open the front of the building.

E-10 arrives and is directed to Division C. The shed has already begun to collapse.

E-10 crew cannot get past the burning shed, so the crew assists the fire fighters assigned to Division B until the fire in the shed is knocked down.

E-20 fire fighter accidentally opens the bypass valve on his SCBA while stretching the crews 2 1/2-inch hose line.

9:26 p.m. Flames can be seen above the roof along the full length of the south and west walls of Section G. Heavy smoke is coming from the soffit area (west wall) of Section E.

9:30 p.m. E-25 arrives and is assigned to Division A.

9:31 p.m. Second alarm: E-22, E-41, L-10, and BC-4 respond.

E-20 crew leaves building in an attempt to confirm the location of the fire.

E-20 crew sees that the fire is still in the southwest corner of the building.

L-1 arrives and is assigned to the roof.

B-1 feels that the uninvolved area is still very large and that it will be possible to push the fire out of the building.

Fire fighters are on both the east and west sides of the parapet wall between Sections A and G.

E-20 fire fighter changes his air cylinder, but the officer does not.

9:33 p.m. Air 26 dispatched.

L-4 crew attempts to open roof above Section A. High heat and fire come out of holes left by saw blades.

E-20 crew reenters the building.

L-4 fire fighter uses a chainsaw to cut an opening in the door to Section A. E-25 and E-2 crews attempt to make entry.

L-1 arrives and is assigned to go to the roof to assist in ventilation operations. The roof commander is informed of this assignment.

Fire fighter from E-2 is in Section B of building and overhears E-20 crew talking. Sounds as if they are talking through their masks.

L-4 crew moves to a point further east above Section A and makes another cut. This hole also fills with smoke and flames.

9:33 p.m. Fire fighters from L-1 open roof in Section B and find no fire and some smoke.

E-20 officer is at the nozzle, and E-20 fire fighter leaves to search the mezzanine area for fire extension.

E-5 crew told to pump in the sprinkler system siamese connection.

9:43 p.m. Second Special Call: E-31 and E-36 respond.

Flames explode out of the west wall of Section F.

9:44 p.m. Third alarm: E-6, E-11, E-21, and L-7 respond.

B-1 can see that conditions toward the north side of building are deteriorating rapidly. Fire is starting to increase in intensity and he does not know what is burning.

Front of the building is in good shape, but the back part is really cooking.

E-9 is directing its monitor nozzle into the south portion of the building.

E-10 begins to direct its monitor nozzle into the burning building.

Fire fighters on roof stands by front (east) wall of Section B.

E-20 fire fighter returns to the nozzle, and conditions in Section B change dramatically. High heat and smoke fill the area.

9:45 p.m. Assistant Chief of Operations (ACO) arrives on scene. He parks his car north of the fire building and walks around to assess the situation.

E-5 crew connects a 2 1/2-inch hose between the sprinkler system's fire department siamese and the E-2 manifold.

E-9 directs its monitor nozzle into the building (south side).

E-10 begins to direct its monitor into the building (south side).

9:45 p.m.

Air 26 arrives.

E-20 fire fighter finds that his officer is not at the nozzle and goes to find him.

Flames visible along the entire west wall of the building.

Battalion Chief of Medics (ACM) is on the scene.

9:47 p.m.

Third Special Call; E-38 and L-8 respond.

Once outside the building, E-20 fire fighter talks to a man with a clipboard and tells him that there might be a missing fire fighter. The E-20 fire fighter then reenters the building.

Heaviest flames at the northwest and southwest corners of building. Flames in these corners are 80 - 100 feet high. Flames along the rest of the west wall are 60 - 80 feet high.

E-20 fire fighter finds his officer, and the officer makes several radio transmissions requesting assistance.

E-20 officer indicates that he has low air, gives the radio to the fire fighter, and lies down in the building.

E-20 fire fighter also attempts several radio transmissions to get assistance. He receives no response but can hear "move up" orders being given to responding units.

Fire fighters open roof above Section B and find smoke but no fire.

Special alarm for BC-7.

E-20 fire fighter decides to leave the officer and to attempt to find his way out of the building to get assistance.
L-8 arrives. Crew assigned to staging.

E-20 fire fighter becomes disoriented while attempting to leave the building and eventually enters an office area.

10:00 p.m.

ACO assumes command of the fire and B-1 becomes the operations chief.

Fire involves Sections A, C, D, E, F, and G.

10:00 p.m. E-2 fire fighter hears a PASS device activate in the office and sees a fire fighter walking around inside. This fire fighter is the E-20 fire fighter, and he staggers out of the building.

E-20 fire fighter does not have his facepiece on, his face is cherry red, his coat is crisp, and he appears to be disoriented.

B-2 sees the two fire fighters outside the building apparently having difficulty, and goes to see what the problem is.

B-2 tells the E-2 fire fighter to bring the injured fire fighter to the medics.

B-2 believes that both fire fighters were from E-20 and makes a notation that E-20 crew is out of the building.

10:07 p.m. Flames visible in the north wall up to the dust collector

ACO orders crews off the roof.

10:08 p.m. Special alarm; E-16, E-27.

E-20 fire fighter is brought to Med 10 by E-2 fire fighter.

L-1 fire fighter brought to Medics.

Deputy Chief of Safety arrives. Monitors safety procedures.

10:15 p.m. A third deputy chief is on scene and assumes command of staging, and BCM assumes command of the medical units.

10:18 p.m. Fourth alarm; E-13, E-38, and L-9 respond.

L-8 fire fighter is assigned to go the hospital with Med-10.

E-13 arrives.

10:25 p.m. E-20 fire fighter's transported to hospital.

Large ball of blue flames blows out of the front of Section B.

10:25 p.m. The last fire fighter coming off the roof is almost burned by the blue flames coming out of Section B.

E-38 arrives. Assigned to Division C. E-4 pumps into E-38.

10:28 p.m. Aid 28 dispatched.

10:29 p.m. B-4 dispatched.

10:35 p.m. E-20 fire fighter is admitted to the hospital. (Time of admittance provided by hospital records.)

10:40 p.m. Captain Safety Division arrives. Reports to Chief of Safety.

L-8 fire fighter returns from hospital with the E-20 fire fighter's gear and radio.

L-1 fire fighter leaves for hospital in Aid 28.

11:12 p.m. L-1 fire fighter is admitted to hospital.

L-8 officer tells staging commander that something is wrong because he has the radio from the E-20 officer.

Staging Commander tells the L-8 officer that the E-20 officer will show up and that he will return the radio to E-20 vehicle.

**11:15 -
11:30 p.m.** Safety Captain is working Division A when the L-8 fire fighter asks him about the status of the E-20 officer.

Safety Captain's conversation with the fire fighter reveals that the officer might be missing.

Safety Captain tells the AC of Safety, and the search for the missing officer begins in areas outside the building.

Entry into building is impossible due to flames.

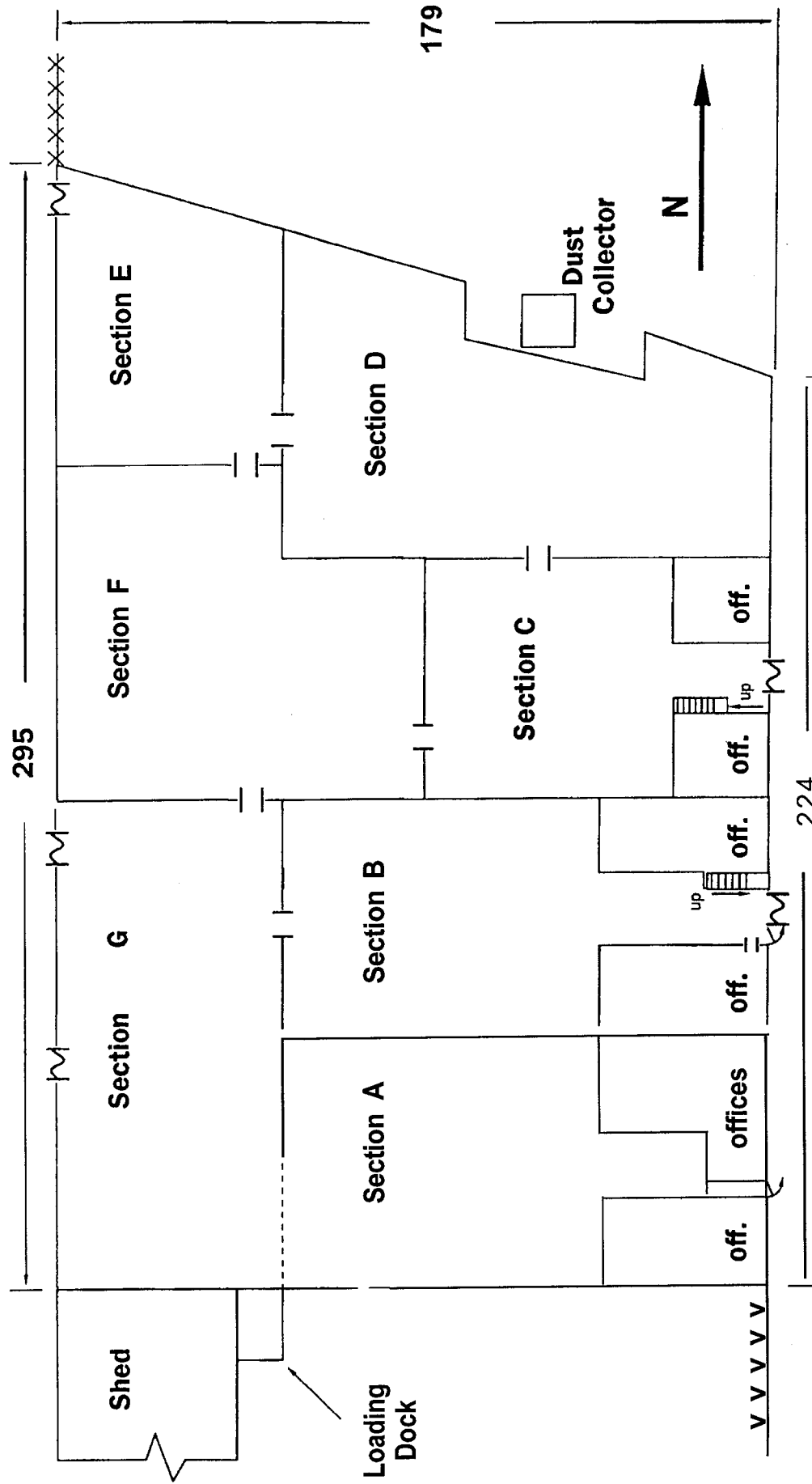
11:40 p.m. Med-10 responds back to hospital Code Red and informs ACM via radio that E-20 fire fighter had been inside the building with E-20 fire officer.

11:48 p.m. Interior search for the missing fire officer begins.

11:48 p.m. Fire is considered under control, e.g. "tapped", but entry into the building is impossible because of remaining flames.

12:30 a.m. Three search teams enter building from east side.

1:00 a.m. Body of the missing fire officer is found in Section B.



⌂	Personnel Door
M	Vehicle Door
- -	Interior Door

Building Plan View

Figure 1

Note: Dimensions are in feet

E-4

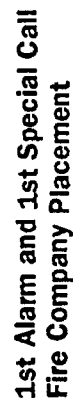


Figure 2

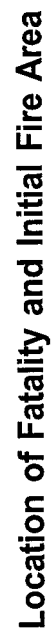


Figure 3

Part 1, Appendix C
Seattle Fire Fighter Fatality, July 12, 1987

On July 12, 1987 a Seattle Fire Fighter died while working alone in a structural fire. The following material regarding that incident was taken from the *Fire Command* article on "Fire Fighter Fatality Report, Individual Incidents", June 1988.

"Exposure to Fire Products: A 41-year-old career fighter in Seattle, Washington died of asphyxia when he was trapped in a third floor room during a fire involving a vacant, 40-room apartment building.

The partial brick and wood frame three-story structure with a 4100-square foot ground floor area was vacant except for a small neighborhood grocery store on the first floor. The building, which was scheduled for demolition, was not equipped with automatic detection or suppression equipment.

At about 1600 hours, a passerby entered the first floor grocery store and informed two occupants that there was a fire on the second floor. Earlier, the occupants had smelled what they believed to be rubber burning, but they failed to find the source of the odor. At 1602 hours, the fire department's dispatch center received a telephone call reporting the fire. First arriving fire fighters began an aggressive interior attack supported by ventilation. All fire fighters were in full protective gear including SCBA. As fire fighters operated on the second and third stories, the fire spread horizontally on the second story and vertically through non-fire stopped walls to the third story and cockloft. The fire also extended to a small area of an exposed vacant structure, but this fire was quickly contained. The building presented serious access difficulties, as many windows were boarded up and held in place with lag screws.

About an hour into firefighting operations, it was discovered that a fire fighter who was not working on his regular shift assignment was missing. A search was begun and within a short time an unconscious fire fighter was discovered in a small third-story room at the end of a hallway. The window in the room was still boarded up. The 15-year veteran fire fighter was removed to the outside and CPR was started. He was transported to a local hospital, where he died of inhalation of products of combustion.

The fire fighter had been operating on the third story by himself when fire development in the hallway apparently trapped him in the small room with the boarded window. His SCBA air cylinder became depleted, and he apparently removed his facepiece and immediately was exposed to the toxic atmosphere. A blood gas analysis revealed a 38 percent carbon monoxide level.

Investigation into the fire cause revealed that a transient apparently living in the building had started a fire intentionally in a stack of paper in a second-story room, then had left the building. The 24-year-old transient

was arrested later. A jury subsequently found the suspect guilty of first degree murder for setting a fire that resulted in the fire fighter's death."

The Seattle Fire Department also reported that the fire fighter had removed all of his protective gear, including his SCBA, prior to being found by other fire fighters. The gear did not appear to be randomly thrown down.

Part 2, Appendix C
Fill Station Air Quality Test Results

Testing Facility: University of Washington
School of Public Health and Community Medicine
Department of Environmental Health

Test Performed by: Research technologist under the supervision of a
certified industrial hygienist.

Test Date and Results:

a) August 11, 1989

<u>COMPONENTS</u>	<u>RESULTS</u>		<u>COMPRESSED GAS</u> <u>ASSOCIATION STANDARD</u> Code D (For normobaric use)
	<u>Station 9</u>	<u>Air 26</u>	
Oxygen (%)	21	21	21
Carbon dioxide (ppm)	217	319	1000
Carbon monoxide (ppm)	2*	3	20
Hydrocarbons (ppm)	2*	2*	-
Oil Mist (mg/m ³)	none	none	5
Odor	OK	OK	Pronounced

b) September 14, 1989

<u>COMPONENTS</u>	<u>RESULTS</u>		<u>COMPRESSED GAS</u> <u>ASSOCIATION STANDARD</u> Code D (For normobaric use)
	<u>Station</u>	<u>Air 26</u>	
Oxygen (%)	21	21	21
Carbon dioxide (ppm)	260	398	1000
Carbon monoxide (ppm)	2*	7	20
Hydrocarbons (ppm)	2*	2*	-
Oil Mist (mg/m ³)	none	none	5
Odor	OK	OK	Pronounced

* Detection Limit

Part 3, Appendix C
Results of Sample Tests for Officer of E-20

Tests performed at Harborview Medical Center by a medical technologist in the medical examiner's department:

<u>SAMPLE MATERIAL</u> (Vitreous Fluid)	<u>RESULT</u>
Acetone (semi-quant), Fluid	Negative
Creatinine, Fluid	1.0 mg/dl
Glucose, Fluid	12 mg/dl
Electrolytes, Fluid	
Sodium, Fluid	126 mEq/L
Potassium, Fluid	2.2 mEq/L 4.5 - 5.5
Chloride, Fluid	107 mEq/L
Urea Nitrogen, Fluid	18 mg/dl

Tests performed at Washington State Toxicology Laboratory:

<u>SAMPLE MATERIAL</u>	<u>QUANTITY</u>	<u>CONTAINER</u>	<u>RESULT</u>
Blood	8 ml	IV6	Carboxyhemoglobin - 60% Blood Cyanide - Less than 0.25 mg/L Alcohol - Negative
Urine	60 ml	IPC	Caffeine detected

Part 4, Attachment C
Test of the Facepiece from the E-20 Officer's SCBA

Date of Test: December 28, 1989

Location: Seattle Fire Department Commissary

Equipment Used: Biosystems Inc. Posicheck machine equipped with a "Sierra" model mannequin head.

Equipment Operators: Test Technician from Washington State Labor and Industry.

Hygienist from Washington State Labor and Industry

Others in Attendance at Test: Seattle Fire Department Safety Officer
Washington State Labor and Industry Safety Inspector
Washington State Labor and Industry Observer
Seattle Police Department Detective
Seattle Fire Department SBCA Repair and Maintenance Technician.

<u>Printout from Testing Equipment:</u>	Mask Leak	PASS
	Exhalation Valve	1.6 in H ₂ O
	Static Pressure	1.1 in H ₂ O PASS
	HI Pressure Leak	128 PSI PASS
	Breathing Resistance	
	Max Work	PASS
	Min Mask Pressure 0.5 in	H ₂ O
	Max Mask Pressure 2.7 in	H ₂ O
	Pressure Gauge Accuracy	N/A
	Alarm Accuracy	987 PSI PASS

Problems Encountered During the Test: The first few attempts to obtain a seal were unsuccessful. The exhalation valve was removed, blown out with compressed air and reinstalled. Again, a seal could not be obtained.

Testers realized the facepiece and mannequin were not creating a good seal. After adjusting the facepiece position on the mannequin, the seal was obtained, and the test was performed.

Result of Test: The facepiece passed all portions of the test.

3. The buckle is broken at the extended end and melted at the receiver end.
4. Both shoulder straps are partially burned through.
5. Cylinder gauge is melted; the cylinder is open and empty.
6. The back pack is intact.

- REGULATOR:**
1. The regulator pressure gauge is 1/3 full of water.
 2. The high pressure hose connection is tight.
 3. The O-ring is intact on high pressure hose.
 4. High pressure hose wrapping is melted.
 5. The main line valve is wide open.
 6. The bypass valve is closed.
 7. The regulator cover is removed:
 - a. The spring is in place.
 - b. There is a slight evidence of soot.
 - c. The diaphragm is intact.
 - d. There is a small sliver of brass that probably came off of the regulator cover.
 8. The alarm bell is very dirty inside and out.
 9. The alarm bell inlet valve is clean and the O-ring is intact.
 10. The regulator gauge rubber protector is dislodged.

- PASS DEVICE:**
1. 2/3 melted.
 2. In the "on" position.
 3. Worn on left shoulder.

The regulator was connected to test equipment and a bench test was performed. Following are the results:

1. Apply 500 PSI - alarm bell operates.
2. At 1180 PSI, the alarm bell quits ringing.
3. Increase pressure to 2420 PSI - high pressure hose and regulator still OK (no leaks) and regulator holding 1.3 static pressure.
4. Meets the liters per minute flow (400) and maintains positive pressure.
5. The bypass is working - 200 liters per minute at .7 pressure.
6. The pressure gauge is working correctly.
7. The air pressure is released and the alarm bell rings from 980 PSI down to 100 PSI.

This completed the mask test. The examiner was asked for the record, "Did you find anything during the course of your investigation to indicate that the mask had failed?" The examiner replied that "The mask worked correctly then and now."

Part 5, Attachment C
Record of SCBA Inspection

September 18, 1989

Place: Seattle Fire Department Commissary - 3825 Linden Ave. N.
Date: September 12, 1989 at 10:45.

In Attendance: Representatives from Seattle Police Department,
Seattle Fire Department, Washington Labor and
Industries Safety, Local #27 Union and the SCBA
Manufacturer, SFD Mask Repair and Maintenance
Expert

The self-contained breathing apparatus that was being worn by the E-20 officer was examined at the Seattle Fire Department Commissary by the Seattle Fire Department Mask Repair and Maintenance Expert on September 12, 1989.

The inspection began with a visual check to see if anything looked obviously wrong. The technician performing the inspection said that the mask looked alright from all external indications. The mask was intact, and all hoses were connected.

The mask was then inspected piece by piece with the following observations:

- FACE PIECE:**
1. Lens cover is melted through on the left side.
 2. Lens ring is discolored on the left side.
 3. The lens itself is not melted through.
 4. The nose cone is in its proper place.
 5. There are a few light colored hairs measuring 2" to 3" in the nose cone.
 6. The neck strap is burned 3/4 of the way through.
 7. There is soot in the interior of the facepiece and exhalation valve cover.
 8. The exhalation valve spring is intact.
 9. The low pressure hose looks fine. The gasket is in its proper place.
 10. The facepiece looks to be intact.
 11. Facilities not available to perform a fit test on the facepieces of M.S.A. masks.

- BACK PACK:**
1. Intact; SFD #153.
 2. Underarm strap is cut on both the right and left side. (This was done at the fire scene to facilitate check for vital signs - this information was provided by Deputy Chief Rose).

Part 6, Attachment C
Breathing Apparatus Test Record Sheet

DATE: September 12, 1989
TESTED BY:

Manufacturer:

Serial Number: SFD 153

Type of Unit: Demand_____ Pressure-Demand X

TEST RESULTS

		<u>ACCEPT</u>	<u>REJECT</u>
Group A	Test 1 Facepiece Leakage	_____	_____
	Test 2 Exhalation Valve Leakage	_____	_____
Group B	Test 3 Cylinder Pressure Gauge	_____	_____
	Test 4 Regulator Pressure Gauge	<u>OK</u>	_____
	Test 5 High Pressure Connections	<u>OK</u>	_____
Group C	Test 6 Alarm	<u>980 PSI</u>	_____
Group D	Test 7 Lockup Pressure	<u>1.3</u>	_____
	Test 8 Regulator Leakage	<u>OK</u>	_____
Group E	Test 9 Exhalation Resistance	_____	_____
	Test 10 Exhalation Flow	_____	_____
Group F	Test 11 Inhalation Resistance	<u>500</u>	_____
	Test 12 Inhalation Flow	<u>400</u>	_____
Group G	Test 13 Bypass Flow	<u>200</u>	_____

Remarks: "Just did a visual check on the mask, for no way to check mask on a machine or head. The cylinder gauge could not be read, for the lens was bubbled up from the intense heat."

